

Amended claims JC09 Rec'd PCT/PTO 17 OCT 2009

1. Quick-action clamping cylinder comprising a housing (1) and a cover (2) covering the housing, the cover (2) having a center opening (32) for receiving a retractable nipple (3) arranged on the lower side of a workpiece pallet (68), and a plurality of locking balls (21) providing a spring-loaded lock for the retractable nipple in the housing, wherein the locking balls (21) are in the locked position in spring-loaded contact with the outer periphery of the retractable nipple (3) and move into the unlocked position by disengaging from the retractable nipple through movement of a piston (4) operated by pressure means, **characterized in that** the locking balls (21) convert the spring force exerted by the springs (7) through a transmission ratio of a lever arm into a multiple of the retraction force applied to the retractable nipple (3), wherein the piston (4) has a chamfer (25) with a slope smaller than a self-locking threshold (< 7 degrees).
2. Quick-action clamping cylinder according to claim 1, characterized in that the piston (4) forms at least one chamfer (25) with a small slope in the radial inward direction, wherein the locking balls (21) contact the chamfer (25) in the locked position in a first ball position (24) for transmitting a load, wherein the locking balls (21) further contact in another ball position (22) the bottom side of the cover (2), and wherein the locking balls (21) further contact in a third ball position (23) a chamfer (28) with the opposite slope on the outer periphery of the retractable nipple (3).
3. Quick-action clamping cylinder according to claim 1 or 2, characterized in that the piston (4) is displaceably and sealingly guided between the surfaces of the cover (2) and of the housing (1).

4. Quick-action clamping cylinder according to claims 1 to 3, characterized in that the part of the piston (4) contacted by the locking balls (21) is formed as a bendable ring-shaped projection (104).
5. Quick-action clamping cylinder according to one of the claims 1 to 4, characterized in that the outside of the piston (4) includes sealing rings which sealingly contact an unsupported cover projection (105) of the cover (2).
6. Quick-action clamping cylinder according to one of the claims 1 to 5, characterized in that each spring (7) contacts with a radial outward section a radially outwardly oriented, upper spring support surface (35) on the bottom side of the piston (4) and a radially outwardly oriented lower spring support surface (36) of the spring support (6).
7. Quick-action clamping cylinder according to claim 6, characterized in that the outwardly oriented, upper spring support (35) is approximately aligned below a cylinder space (12), so that the cylinder space (12) is not deformed when the locking engagement is released.
8. Quick-action clamping cylinder according to one of the claims 6 or 7, characterized in that the lower spring support (6) and hence the entire locking device is fitted and held in the tubular housing (1) of the clamping system by locking balls (8), which are uniformly distributed along the periphery.

9. Quick-action clamping cylinder according to one of the claims 1 to 8, characterized in that a cylinder space (12) having a small volume is provided by an opposing arrangement of a cover projection (105) in the cover (2) and an offset in the piston (4).

10. Quick-action clamping cylinder according to one of the claims 1 to 9, characterized in that the cylinder space (12) is arranged radially outwardly in the tubular housing (1), in particular proximate of the radially outwardly arranged screws (19) between the cover (2) and the tubular housing (1), so that the screws (19) absorb deformation forces to which the cover (2) may be subjected.

11. Quick-action clamping cylinder according to claim 10, characterized in that the transition region in the cover (2) between the downwardly extended cover projection (105) for guiding the piston (4) and the region of the cover (2) through which the screws (19) extend, is formed so as to be capable of transmitting a large load and protected against deformations.

12. Quick-action clamping cylinder according to one of the claims 10 or 11, characterized in that the cover (2) has a small(er) material thickness in the region that extends radially inwardly as viewed from the extended cover projection (105).

13. Quick-action clamping cylinder according to one of the claims 1 to 12, characterized in that on the piston (4), a chamfer (25) with the small slope is followed in the axial direction by a chamfer (26) with a greater slope.

14. Quick-action clamping cylinder according to one of the claims 1 to 13, characterized in that a conical tip of the retractable nipple (3) engages with the center interior space (30) in the clamping cylinder, where it centers in an opposing conical recess.

15. Quick-action clamping cylinder according to one of the claims 1 to 13, characterized in that the blow-off air is supplied to a tubular housing (1) via an air connection (44), from where it reaches via an ascending vertical bore the lower region of the tubular housing (1), where the air enters a circumferential recess (9).

16. Quick-action clamping cylinder according to claim 15, characterized in that the blow-off air flows between the bottom side of a spring support (6) and the inside of the cover (42) through a gap (43) extending approximately over the entire diameter of the bottom side of the housing, and branches to the outside region of the clamping system by way of a first air pathway through the recess (9) arranged along the outer periphery, and to the center interior region of the clamping system by way of a second air pathway.

17. Quick-action clamping system with a quick-action clamping cylinder according to one of the claims 15 or 16, characterized in that the blow-off air produces an air flow directed at an angle against the bottom side of the locking balls (21), with the air flow rotatably driving the locking balls, causing them to circulate in the peripheral direction about the retractable nipple.

18. Quick-action clamping system with a quick-action clamping cylinder according to one of the claims 1 to 17, characterized in that the retractable nipple (3) is connected with a catch screw

(56), which cooperates with a catch device disposed on a reciprocating piston (87) of the clamping system, wherein the catch device catches the retractable nipple exiting the opening in the clamping system and retracts the retractable nipple into the clamping system.

19. Quick-action clamping system with a quick-action clamping cylinder according to one of the claims 1 to 18, characterized in that the ball support (5) and the spring support (6) are connected with each other, forming a built-in module (57, 58, 59) which clamps the springs (7).

20. Quick-action clamping system with a quick-action clamping cylinder according to one of the claims 1 to 19, characterized in that the quick-action clamping system is mounted in a machine table as a built-in module (80) configured as a built-in cartridge.

21. Quick-action clamping system with a quick-action clamping cylinder according to claim 20, characterized in that the lower spring support (6) is connected with a cylindrical tube (74) made of the same material (as a single piece) to form the cylinder for guiding the piston (4).